

Message Text

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BRUSSELS FOR ERDA

DEPT ALSO PASS ERDA FOR JOHN TEEM

E.O. 11652: N/A

TAGS: TECH ENRG UK

SUBJECT: UK CENTRAL ELECTRICITY GENERATING BOARD ASSESS-
MENT OF ALTERNATIVE ENERGY SOURCES

REF: LONDON A-056

1. ON APRIL 14 D.R.R. FAIR, D. LEASON AND J. K. WRIGHT
TESTIFIED BEFORE THE HOUSE OF COMMONS SELECT COMMITTEE
ON SCIENCE AND TECHNOLOGY, ENERGY RESOURCES SUBCOMMITTEE,
REGARDING ALTERNATIVE ENERGY SOURCES AS VIEWED BY THE
CENTRAL ELECTRICITY GENERATING BOARD. CEGB IS THE MAJOR
STATE-OWNED POWER GENERATING COMPANY WITH AN OVERALL
CAPACITY OF APPROXIMATELY 62 GWE.

2. THE CEGB SPOKESMEN REVIEWED THE PROSPECTS FOR WAVE
POWER, GEOTHERMAL POWER, WINDPOWER AND SOLAR ENERGY AS
FAR AS THE CURRENT STATE OF DEVELOPMENT AND POTENTIAL
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SIGNIFICANCE TO LARGE SCALE POWER GENERATION. THEIR

COMMENTS ARE SUMMARIZED IN THE FOLLOWING.

3. WAVE POWER. THERE IS, AVERAGED OVER THE YEAR, ABOUT 80 KW OF POWER IN EACH METER OF WAVE FRONT APPROACHING THE UNITED KINGDOM FROM THE NORTH ATLANTIC. THIS IMPLIES THE AVAILABILITY WITHIN UK TERRITORIAL WATERS OF MORE THAN 120 GW IN THE WAVES - SOMEWHAT GREATER THAN THE ENERGY CONTENT OF UK ANNUAL COAL PRODUCTION AT THE PRESENT RATE. NOT ALL THIS POWER COULD BE HARNESSED AND THERE WOULD BE INEVITABLE LOSSES IN GETTING IT TO ENERGY USERS. IT IS A DIRECT SOURCE OF MECHANICAL POWER WITH THE ADVANTAGE OF AVOIDING THE COMPLEXITIES AND LOSSES OF HEAT ENGINES, BUT THE DISADVANTAGE OF GREATER PROBLEMS OF TRANSMISSION THAN ARISE WITH CONCENTRATED ENERGY IN THE FORM OF FOSSIL FUELS. DIRECT MECHANICAL OR HYDRAULIC TRANSMISSIONS TO INLAND USERS OF MECHANICAL POWER LOOKS UNPROMISING. THE ALTERNATIVE OF CONVERSION TO ELECTRICITY FOR ONWARD TRANSMISSION RAISES PROBLEMS OF THE COLLECTION AND CONCENTRATION OF "DILUTE" POWER FROM LONG LENGTHS OF COASTLINE. WAVE POWER PLANT MAY NOT SIGNIFICANTLY REDUCE THE AMOUNT OF OTHER GENERATING PLANT REQUIRED, BECAUSE ELECTRICITY CONSUMERS HAVE TO BE SUPPLIED DURING PERIODS OF CALM SEAS WHICH CAN PERSIST FOR SEVERAL DAYS AT A TIME. THE CAPITAL COST IS THEREFORE ALMOST WHOLLY ADDITIONAL COST. WAVE-GENERATED ELECTRICITY, HOWEVER, COULD BE USED AS AND WHEN AVAILABLE TO REDUCE THE CALLS MADE ON OTHER GENERATING PLANT USING OTHER FORMS OF ENERGY AVAILABLE AS NATURAL RESOURCES.

THERE ARE FORMIDABLE TECHNICAL PROBLEMS TO BE OVERCOME BEFORE WAVE ENERGY COULD BE CAPTURED AND MADE AVAILABLE AS A FURTHER SOURCE OF USEFUL POWER WITHIN AN EXISTING ECONOMY ON A COMMERCIAL BASIS. THESE ARE HIGHLIGHTED IN A PAPER TO THE SECRETARY OF STATE FOR ENERGY'S ADVISORY COMMITTEE ON RESEARCH AND DEVELOPMENT (ACORD), REFERENCE NUMBER FPRD (75) 40. THIS REVIEW, TOGETHER WITH ONE CARRIED OUT BY THE NATIONAL ENGINEERING LABORATORY, LED ACORD TO CONCLUDE THAT THE TOPIC WAS OF SUFFICIENT IMPORTANCE FOR A NATIONAL PROGRAM OF WORK TO BE UNDERTAKEN. A STEERING COMMITTEE--CHAIRMAN BY THE DIRECTOR

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TOR OF HARWELL AND ON WHICH THE CEGB IS REPRESENTED-- HAS BEEN SET UP TO FORMULATE A GOVERNMENT FUNDED PROGRAM OF RESEARCH WHICH WOULD EXTEND OVER A PERIOD OF ABOUT TWO YEARS AND WOULD PROGRESS THE DEVELOPMENT TO A STAGE WHERE FIRMER ASSESSMENTS ARE OBTAINED OF THE POTENTIAL OF SEVERAL POSSIBLE METHODS OF HARNESSING WAVE ENERGY, INCLUDING THEIR PRACTICAL ENGINEERING FEASIBILITY AND ENVIRONMENTAL IMPACT.

THE CEGB IS CURRENTLY DEPLOYING RESOURCES VALUED AT ABOUT 60,000 POUNDS STERLING PER ANNUM ON WAVE ENERGY RESEARCH--SO FAR AS WE ARE AWARE THIS IS CURRENTLY THE LARGEST SINGLE PROGRAM OF WORK BEING UNDERTAKEN ANYWHERE IN THE WORLD. THE RESULTS WILL BE MADE AVAILABLE TO THE NATIONAL PROGRAM BUT STUDY IS AIMED PRIMARILY AT ENABLING THE INFORMED ASSESSMENTS OF THE PROBABILITY OF ULTIMATE SUCCESS TO BE MADE AND TO ENSURE THAT THE PROBLEMS OF

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MATCHING IN TO THE ELECTRICITY SUPPLY SYSTEM ARE FULLY TAKEN INTO ACCOUNT IN THE DEVELOPMENT PROGRAM AS IT GETS UNDERWAY.

2. GEOTHERMAL POWER. SMALL AMOUNTS OF ELECTRICITY ARE GENERATED IN A FEW COUNTRIES FROM GEOTHERMAL SOURCES, FOR EXAMPLE, SOME TWO PERCENT OF THE ANNUAL ELECTRICITY REQUIREMENTS OF ITALY. THERE ARE NO KNOWN COMPARABLE SOURCES OF GEOTHERMAL STEAM AVAILABLE IN THE UNITED

KINGDOM.

HOWEVER, IT SEEMS PROBABLE THAT DRY ROCK TEMPERATURES IN THE REGION OF 200 DEGREES TO 300 DEGREES CENTIGRADE WOULD BE EXPERIENCED AT DEPTHS OF FIVE TO SEVEN KILOMETERS IN CORNISH GRANITE, AND THESE WOULD BE SUFFICIENT TO RAISE STEAM FOR ELECTRICITY GENERATION IF THE HEAT COULD BE EXTRACTED. OIL WELLS ARE OFTEN DRILLED TO THESE DEPTHS BUT IN SOFTER ROCKS. GRANITE IS A POOR THERMAL CONDUCTOR AND IT WOULD HAVE TO BE CRACKED AND A LARGE SURFACE AREA EXPOSED AT DEPTH BEFORE SIGNIFICANT

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AMOUNTS OF ENERGY COULD BE EXTRACTED.

A LARGE AND EXPENSIVE EXPERIMENT IS UNDERWAY AT LOS ALAMOS IN THE UNITED STATES TO ESTABLISH WHETHER ENERGY CAN, IN FACT, BE EXTRACTED FROM SUCH "HOT DRY ROCKS." A HOLE IS DRILLED TO THE REQUIRED DEPTH AND THE ROCK CRACKED BY HYDROFRACTING TO EXPOSE A LARGE SURFACE AREA. A SECOND HOLE IS DRILLED TO MEET THE CRACKED ROCK. WATER UNDER PRESSURE IS PUMPED DOWN ONE HOLE AND HOT WATER IS RECOVERED FROM THE OTHER. THE BIG PROBLEM IS WHETHER TECHNIQUES CAN BE DEvised TO EXPOSE CONTINUOUSLY A FRESH HOT SURFACE. THE RESULTS OF THE LOS ALAMOS EXPERIMENT ARE AVAILABLE TO US. AS A SMALL CONTRIBUTION TO THE PROGRAM THE CEGB IS DEVELOPING A THEORETICAL METHOD OF CALCULATING WHETHER ROCKS CAN BE MADE TO CRACK BY THE THERMAL GRADIENTS SET UP AS THE HEAT IS EXTRACTED. THIS WILL ENABLE THE RESULTS OF THE LOS ALAMOS EXPERIMENTS TO BE INTERPRETED AND APPLIED TO THE UK SITUATION. A SUGGESTION THAT UNDERGROUND NUCLEAR EXPLOSIONS MIGHT BE USED TO RELEASE GEOTHERMAL POWER DOES NOT, HOWEVER, SEEM WORTH PURSUING IN THE UK.

IT WILL BE APPRECIATED THAT THIS FORM OF GEOTHERMAL POWER IS AT A VERY EARLY RESEARCH STAGE AND IT IS NOT POSSIBLE TO ASSESS MEANINGFULLY ITS CHANCES OF ULTIMATE SUCCESS. HOWEVER, IF THE METHOD WERE FEASIBLE, BOTH TECHNICALLY AND ECONOMICALLY, IT WOULD MAKE AVAILABLE A QUANTITY OF ENERGY CAPABLE OF SUPPLYING UK NEEDS FOR HUNDREDS OF YEARS. IT IS NOT YET CLEAR WHETHER IT WOULD BE PREFERABLE TO EXPLOIT SUCH A SOURCE AS LOW GRADE HEAT OR ELECTRICITY. ACORD HAVE RECENTLY REVIEWED THE TOPIC AND THE DEPARTMENT OF ENERGY HAS SET UP A STEERING COMMITTEE (ON WHICH THE CEGB IS REPRESENTED) TO FORMULATE A UK NATIONAL PROGRAM. THE EEC IS ALSO FORMULATING A EUROPEAN PROGRAM OF WORK IN THIS AREA.

5. WIND POWER. WINDMILLS ARE AVAILABLE COMMERCIALY AND MAY BE FUTHER USED FOR PUMPING WATER, PROVIDING HEAT OR GENERATING ELECTRICITY. THEY FIND MOST APPLICATION IN REMOTE, WINDY SITES. AS WELL AS THESE SMALL WIND-

MILLS, IT IS TECHNICALLY FEASIBLE TO PRODUCE WIND GENERATORS IN UNIT SIZES UP TO ABOUT ONE MW.

A CONSIDERABLE AMOUNT OF WORK ON THE LARGE SCALE
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GENERATION OF WIND POWER WAS CARRIED OUT IN THE UNITED KINGDOM DURING THE 1950S. UPDATING THESE STUDIES AND ALLOWING GENEROUSLY FOR IMPROVEMENTS IN TECHNOLOGY WHICH HAVE OCCURRED SINCE THAT TIME, WIND POWER IS STILL UNABLE TO COMPETE ECONOMICALLY WITH OTHER AVAILABLE FORMS OF ELECTRICITY GENERATION FOR PUBLIC SUPPLY, EXCEPT POSSIBLY AT A LIMITED NUMBER OF VERY WINDY SITES. THESE ARE MAINLY ON HILL TOPS IN THE WEST OF THE UNITED KINGDOM AND WOULD CAUSE VALID ENVIRONMENTAL OBJECTION BECAUSE THE MASSIVE WINDMILLS WOULD BE VISUALLY OBTRUSIVE IN AREAS OF HIGH SCENIC BEAUTY. IT WILL BE RECALLED THAT IT WAS NOT POSSIBLE TO OBTAIN CONSENT TO SITE AN EXPERIMENTAL GENERATOR ON THE LLEYN PENINSULA DURING THE 1950S.

BY BUILDING A VERY LARGE NUMBER OF MACHINES IT MIGHT BE POSSIBLE TO UTILIZE LESS WINDY SITES AND GENERATE QUANTITIES OF ELECTRICITY COMPARABLE WITH THE PRODUCTION OF A 2,000 MW COAL-FIRED STATION. BECAUSE OF THE VARIABLE NATURE OF THE WIND THERE WOULD BE NO SAVING IN POWER STATION CAPACITY, BUT THERE WOULD BE A SAVING IN FOSSIL FUEL CONSUMED IN POWER STATIONS ON WINDY DAYS. IT IS ESTIMATED THAT THE COST OF HARNESSING THE WIND WOULD EXCEED BY SEVERAL TIMES THE VALUE OF THE FUEL SAVED EVEN AT CURRENT HIGH ENERGY PRICE LEVELS.

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FOR THESE REASONS CONTINUED WORK ON WIND GENERATORS CAN ONLY BE VIEWED AS GIVING A SMALL MEASURE OF INSURANCE AGAINST FUTURE EVENTUALITIES OF VERY LOW PROBABILITY. SINCE DEVELOPMENT WORK IS CONTINUING OVERSEAS IT SHOULD BE POSSIBLE TO BUY IN FOREIGN TECHNOLOGY IF IT WERE EVER SERIOUSLY NEEDED TO SUPPLEMENT PUBLIC ELECTRICITY SUPPLY. IN THESE CIRCUMSTANCES IT IS JUDGED TO BE UNREALISTIC TO CALL ON THE ALREADY OVERBURDENED ELECTRICITY CONSUMER TO PAY FOR FUTURE DEVELOPMENT WORK OF THIS NATURE IN THE UK, ALTHOUGH A SMALL EFFORT WILL BE DEVOTED TO MAINTAINING AN ADEQUATE "WATCHING BRIEF."

6. SOLAR ENERGY. THE UNITED KINGDOM IS NOT WELL FAVORED WITH SOLAR ENERGY. AVERAGED OVER THE WHOLE YEAR (DAY AND NIGHT) THE POWER RECEIVED ON A HORIZONTAL SURFACE IS ABOUT 100 WATTS PER SQUARE METER, RATHER LESS THAN HALF THAT IN SOME OTHER COUNTRIES. A MORE SERIOUS FACTOR IS THAT, BECAUSE OF OUR HIGH NORTHERN LATITUDE, VERY LITTLE ENERGY COMES IN WINTER WHEN IT IS MOST UNCLASSIFIED

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NEEDED, THE SUMMER TO WINTER RATIO BEING ABOUT SEVEN TO ONE. JUST AS GEOGRAPHY FAVORS WAVE POWER IN THE UNITED KINGDOM, OTHER COUNTRIES ARE MORE FAVORED WITH AND HAVE A GREATER ECONOMIC INCENTIVE TO EXPLOIT SOLAR POWER, AND IT IS EXPECTED THAT THEY COULD BE ALLOWED TO BEAR THE MAJOR PORTION OF THE COST OF PIONEERING THE DEVELOPMENT WORK.

IT SEEMS PROBABLE THAT THE FIRST ECONOMIC APPLICATION OF SOLAR ENERGY WILL BE TO PROVIDE AN ALTERNATIVE SOURCE OF ENERGY FOR DOMESTIC WATER HEATING SYSTEMS WITHOUT THE INTERMEDIATE STAGE OF ELECTRICITY PRODUCTION.

ALTHOUGH VARIOUS METHODS EXIST FOR CONVERTING SOLAR ENERGY TO ELECTRICITY, THE COST OF ELECTRICITY PRODUC-

TION BY THIS ROUTE UNDER UK INSOLATION LEVELS WOULD BE
VERY HIGH. THERE COULD WELL BE SPECIAL SMALL SCALE AP-
PLICATIONS IN REMOTE SITES WHERE IT COULD BE ECONOMIC BUT
THESE TECHNIQUES WOULD NOT BE APPROPRIATE TO THE LARGE
SCALE GENERATION OF ELECTRICITY IN THIS COUNTRY.

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